Neglected monteggia fracture-dislocations in children

Ramazan Atiç[1], Azad Yıldırım[2], Şehmus Yiğit[3], Abdulkadir Aydın[1]
[1]Department of Orthopaedics and Traumatology, Dicle University Medical Faculty, Diyarbakir,
[2]Department of Orthopaedics and Traumatology, Private Muş Healing Hospital, Muş,
[3]Department of Orthopaedics and Traumatology, Private Sultan Healing Hospital, Diyarbakır, Turkey

Abstract

Aim: Presently, there are few large-scale studies and no clear consensus on the type of osteotomy or ligamentoplasty to be performed in neglected Monteggia fractures-dislocations cases. The goal of this study was to report the results from neglected Monteggia fractures and dislocations. Material and Method: Thirteen children and adolescents with neglected Monteggia fractures and dislocations were treated between 2009 and 2012. There were 11 males and two females with a mean age of 8.5 (range 2–15) years. Based on the BADO classification, 11 patients had type 1, one patient had type 3, and one patient had type 4 injuries. Time delay from symptom onset to fracture was 8.84 (3-24) months. The data were analyzed using R version 3.1.1 and multiple statistical analyses were conducted. Results: A postoperative Mayo Elbow Performance Index (MEPI) at the time of follow-up was recorded. Nine patients received an excellent grade, while three had good and one had a fair result with no poor results recorded. Radiographically, there were nine good, four fair, and no poor score results. The length of hospitalization was a mean of 3 days. The mean duration of follow-up was 2.9 (range 1.5-4.5) years from the initial presentation, and only one patient developed subluxation for which no additional intervention was performed. Discussion: This case series demonstrates that early diagnosis increases the success rate in patients younger than 10 years and less than a 1-year interval between the trauma and diagnosis. Unless it is kept for a prolonged time, a condyloradial pin can be applied in necessary cases. Level of evidence: IV

Keywords

Monteggia Fracture; Radius Head Dislocation; Pediatric Fractures

DOI: 10.4328/JCAM.5754 Received: 06.02.2018 Accepted: 04.03.2018 Published Online: 07.03.2018 Printed: 01.07.2018 J Clin Anal Med 2018;9(4): 323-8
Corresponding Author: Ramazan Atic, Dicle University Medical Faculty, 21280, Diyarbakir, Turkey.
T.: +905321728629 F.: +90 4122488440 E-Mail: ramazanatic@gmail.com
ORCID ID: 0000-0002-7814-822X

Introduction

Monteggia fractures are defined as fractures of the proximal third of the ulna with anterior dislocation of the head radius [1]. They rarely occur and constitute only 2.0% of all fractures. Unlike adults, treatment with conservative methods is often enough in acute injuries during childhood. However, diagnosis can be delayed in some patients. After a couple of months or longer, these patients can return with complaints of pain, weakness, limited range of motion, disturbed appearance in the elbow, and nerve injury, which includes sensory or motor loss caused by a tardy ulnar nerve palsy or a posterior interosseus nerve palsy [2,3,4].

Treatment processes can become quite complicated in neglected cases or when the diagnosis is delayed. When the interval between time of trauma and treatment exceeds three weeks, conservative treatment does not provide successful outcomes. Surgical treatment is inevitable in these cases. Various procedures have been described for surgical treatment. The most common of these approaches is open reduction of the head of the radius, open wedge osteotomy of the ulna, and/or ligamentoplasty [5]. There is no general consensus on which type of osteotomy or ligamentoplasty is to be performed.

There are few studies on the outcomes of neglected Monteggia fractures. In our study, we present medium and long-term treatment outcomes for neglect cases with Monteggia fracture-dislocation.

Material and Method

In this study, we retrospectively reviewed 13 Monteggia fracture-dislocation neglected cases that were treated in our clinic between the years 2009 and 2012. Before their admittance to the hospital, bonesetters manipulated all of these cases using traditional methods. Eleven of the patients were male and 2 were female, while the mean age of the patients was 8.5 years (range: 2-15). The mean follow-up time was 2.9 years (range: 1.5-4.5 years). Five patients had a fracture-dislocation in their right extremity, and 8 patients were affected in their left extremity. The trauma occurred due to falls from height in 4 patients, simple falls in 4 patients, falls from donkeys in 3 patients, and birth trauma in 2 patients. The average duration between time of trauma and diagnosis was 8.84 months (range: 3-24).

Table 1. Details of preoperative and postoperative findings.

Patients	Age/ gender	Bado type	Fracture type	İnterval (month)	Ligament-oplasty	C.R. Pin	Ulna osteos.	Mean FU(year)	Complication
Case 1	15/M	Type 1	Prox.1/3 ulna diaphysis frx	5	+	+	Plate ost.	4,5	osteoartritis
Case2	7/M	Type 1	Prox. 1/3 ulna diaphysis frx	4	+	_	Plate ost.	2,2	Stifness
Case3	10/M	Type 1	Prox.1/3 ulna diaphysis frx	4	+	+	Plate ost.	3,8	Stifness
Case4	15/M	Type 1	Prox. 1/3 ulna diaphysis frx	5	+	+	Plate ost.	2,3	Delayed Union
Case5	10/M	Type 1	Prox. 1/3 ulna diaphysis frx	4	+	+	Plate ost.	3,7	Subluxation
Case6	8/M	Type 1	Prox. 1/3 ulna diaphysis frx	24	+	_	Plate ost.	3,4	No
Case7	8/F	Type 1	Prox.l 1/3 ulna diaphysis frx	4	+	_	Plate ost..	3,1	No
Case8	2/F	Type 1	Plastic deformasyon	24	+	_	K wire ost.	1,5	No
Case9	8/M	Type 4	Distal -1/3 ulna +radius diaphysis frx.	6	+	_	K wire ost.	2,2	No
Case10	10/M	Type 3	Prox. 1/3 ulna diaphysis frx	5	+	+	Plate ost.	2,1	No
Case11	2/M	Type 1	Plastic Deformasyon on ulna diaphysis	24	+	_	K wire ost.	2,8	No
Case12	10/M	Type1	Prox. 1/3 ulna diaphysis frx	6	+	+	Plate ost.	2,9	No
Case13	6/M	Type1	Ulna proximal metaphsis frx	7	+	_	K wire ost.	3,2	No

FU: Follow up, C.R Pin: Condyloradial pin

Diagnosis was made with anteroposterior (AP) and lateral X-rays of the elbow. Evaluation was made according to the BADO classification. According to the BADO classification, there was anterior dislocation in type 1 and 4 injuries (accompanied by radial diaphysis fracture), posterior dislocation in type 2 injuries, and anterolateral dislocation in type 4 injuries (Table 1). All were in relation to the head of the radius. Based on this classification, 11 of our patients had a type 1 injury, one patient had a type 3 injury, and one patient had a type 4 injury (Table 1). There was no patient with a type 2 injury. Two patients had plastic deformation type fractures, 9 patients had a fracture in proximal ulnar diaphysis, one patient had fractures at the distal third of the radius and ulnar diaphysis, and one patient had fracture at the ulnar metaphysis.

Surgical intervention was performed under general anesthesia. The patients were placed in the supine position with the elbows semi-flexed and the forearms pronated on a conventional surgical table. Tourniquet use was optional, and posterolateral approach was preferred for manipulations on the radial head [6].

The incision was started over the lateral epicondyle of the humerus, continued on the radiocapitellar joint and proximal ulnar metaphysis, and extended until the mid-diaphysis passed from the posterior of the ulna. Additionally, in one case with a type 4 injury, the dorsolateral incision was made over the distal ulna. Intra-articular fibrotic structures were removed. First, an appropriate length was achieved with the ulnar osteotomy (Figure 1-a,b,c,d). The angulation distraction osteotomy was performed

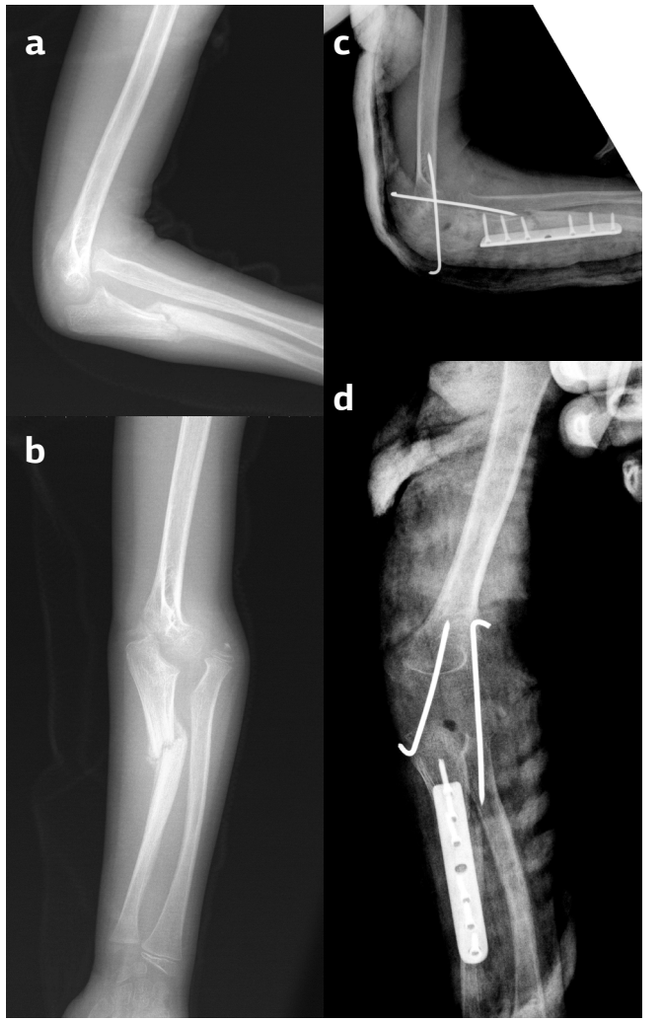

Figure 1. According to BADO classification Type 1 fractures AP graphy (a). According to BADO classification Type 1 fractures Lateral graphy (b). This fracture fixated with plate screws method and condyloradial pin (c-d).

in 12 patients, and proximal metaphysial posterior bending osteotomy was performed in one patient. Later, the head of the radius was reduced and annular ligament repair was performed in 5 patients. Ligamentoplasty with tricipital ligament was performed in 8 patients for whom annular ligament repair was not applicable (Table 1). Following ligamentoplasty, no pin was placed in patients who had a stable radial head, whereas a condyloradial pin was placed in 6 patients with an unstable radial head. As we did not have any patients with distraction length exceeding 10 mm, we did not use a bone graft. The ulna was fixated with plaque-screws in 9 patients and with intramedullary K wire in 4 patients. No cases required radial osteotomy and the mean operation time was 80 minutes (range: 70-90).

Postoperatively, long arm splints were applied to all patients with the forearms in the neutral position. The splints were removed after 3rd-4th weeks, and they were replaced with splints that allowed partial motion and were kept until the 6th week. Approximately 3 weeks after surgery, controlled movements were initiated in order to achieve a full range of motion in the joint. A full load was applied six weeks later, and the patients were examined monthly during the first 6 months followed by visits once every 6 months. Functional evaluation was based on parameters including pain, range of motion, stability, daily life comfort, and Mayo Elbow Performance Index (MEPI) [7]. Radiological evaluation was made using AP and lateral radiograms of the elbow. In radiograms, the head of the radius, osteoarthritic changes, radial frontal neck angle, and radial head hypertrophy were evaluated according to criteria described by Kim et al. [8]. Radiological findings were noted as good (complete reduction of elbow without osteoarthritis), moderate (osteoarthritis of elbow together with resistant subluxation), or poor (complete dislocation of the head of radius).

Data were analyzed using R version 3.1.1 and multiple statistical analyses were conducted. A two-way multivariate analysis of variance (MANOVA) between patients with the independent variables of 2 (treatment group) X 2 (age group) was used to analyze the treatment, age, and interaction (treatment X age) effects on the ROM and MEPI scales. The dependent variables introduced into the analyses were the scores of the ROM (flexion, extension, pronation, supination) and MEPI (pain, motion, daily life) scales. For verifying significant effects of independent variables (treatment and age) on each of the ROM and MEPI scales, we conducted the univariate two-way ANOVA procedure. Following the multivariate and univariate analysis, we also tested to see whether there were significant directional mean differences between groups of patients, older or younger than age 10.

Results

Radiological signs of bone union began to appear at 6th-7th weeks on average. Radiographs at the latest review showed that the radial head was successfully reduced in all cases. According to two-way MANOVA results given in table 2, we concluded that the treatment and age factors affected the ROM and MEPI scales within an additive manner (i.e., without interaction). The univariate two-way MANOVA procedure revealed significant effects of treatment (i.e. Pre-Op and Post-Op) and age (i.e. less or more than 10 years old) on each of the ROM and MEPI scales at any reasonable significance level except for daily life that is not affected by treatment (Table 3 and 4). For both of the ROM and the MEPI scales, patients that were less than ten years old have greater mean scores. We conducted pairwise t-test for each scale to test the null hypothesis and the mean difference between paired scores. No patients had an interval time longer than 1 year when comparing patients older than 10 years old to patients younger than 10 years old. There was no significant difference with regards to MEPI and joint range of motion. There were 3 patients whose interval time was longer than 1 year, and all of them were younger than 10 years old. Three patients younger than 10 years old had a 24-month interval time. All other patients had interval times shorter than 12 months (Table 1).

Radiologically, one patient had an osteochondral lesion, while none of our patients had dysmorphism at the radial head. K wires were removed after 2-2.5 months on average, whereas plaque-screws were removed on average at the 6th month.

Two of our patients developed superficial infection at the bottom of screw that was responsive to treatment. A total of 5 patients developed complications such as subluxation (n:1), osteoarthritis (n:1), delayed bone union (n:1), and elbow rigidity (n:2). One of these patients was younger than 10 years old, and the other 4 patients were older than 10 years old. Three patients developed calcification around the head of the radius (ectopic calcification), postoperatively. None of our patients had a lack of union accompanied with implant failure. None of our patients developed myositis ossificans, complete dislocation, neurological vascular complication, or compartment syndrome. None of our patients required intervention aimed at complications other than the implant removal.

Table 2. Univariate and multivariate analysis of variance at each ROM and MEPI Scales

Univariate Analysis / two - way ANOVA Results						
	Treatment (Pre-Op and Post-Op)		Age (Patients <10 and >10 Years old)		Interaction (Treatment X Age)	
ROM	F	P	F	P	F	P
Flexion	56.80	<.001	57.07	<.001	0.96	0.3376
Extension	9.53	<.001	28.71	<.001	0.37	0.5446
Pronation	5.73	0.025	67.87	<.001	0.03	0.8623
Supination	4.44	0.046	36.11	<.001	0.12	0.7300
MEPI						
Pain	3.25	0.085	37.47	<.001	0.15	0.6948
Motion	2.95	0.099	31.78	<.001	0.98	0.3305
Daily.life	0.09	0.759	11.73	0.002	0.00	0.9811
ROM - Multivariate Analysis / two - way MANOVA Results						
Wilk's Lambda	0.20		0.15		0.94	
Pillai's Trace	0.79		0.84		0.05	
Multivariate F	18.61	P <.001	25.60	P <.001	0.26	P = 0.8953
MEPI - Multivariate Analysis / two - way MANOVA Results						
Wilk's Lambda	0.50		0.34		0.87	
Pillai's Trace	0.49		0.65		0.12	
Multivariate F	6.44	P=0.003	12.87	P <.001	0.98	P = 0.4191

Table 3. Pairwise t tests for ROM scales $(H_0: \mu_1 \leq \mu_2)$

	Group1: Patients <10 Years old			Group2: Patients >10 Year old				
ROM	Mean	SD	CI-95%,+95%	Mean	SD	CI95%,+95%	t	P-Value
Pre-Op								
Flexion	108.28	8.95	90.37, 126.20	92	4.73	82.53, 101.46	4.17	<.001
Extension	-3.71	3.49	-10.71, 3.28	-9.83	3.25	-16.33, -3.33	3.26	0.003
Pronation	69.28	5.49	58.28, 80.28	48.5	7.5	33.49, 63.50	5.61	<.001
Supination	75	10.31	54.37, 95.62	55.33	9.75	35.83, 74.83	3.53	0.002
Post-Op								
Flexion	129.14	4.45	120.24,138.04	108	5.65	96.68,119.31	7.40	<.001
Extension	-1.14	1.06	-3.28,0.99	-6	1.78	-9.57, -2.42	5.81	<.001
Pronation	75.85	5.17	65.50,86.21	54.16	8.01	38.14, 70.18	5.69	<.001
Supination	83.42	5.50	72.42,94.43	61.33	9.17	42.97, 79.69	5.15	<.001

Table 4. Pairwise t tests for MEPI scales $(H_0: \mu_1 \leq \mu_2)$

	Group1: Patients <10 Years old			Group2: Patients >10 Years old				
MEPI	Mean	SD	CI-95%,+95%	Mean	SD	CI-95%,+95%	t	P-Value
Pre-Op								
Pain	43.57	2.29	38.97, 48.16	35	3.03	28.93, 41.06	5.66	<.001
Motion	18.57	1.51	15.54, 21.59	15	1.09	12.80, 17.19	4.92	<.001
Daily life	24.42	0.78	22.85, 26.00	21	1.67	17.65, 24.34	4.60	<.001
Post-Op								
Pain	41.42	3.20	35.01, 47.84	31.66	5.98	19.68, 43.64	3.57	0.004
Motion	19	1	17, 21	16.5	1.76	12.97, 20.02	3.07	0.007
Daily life	24.71	0.48	23.73, 25.69	21.33	4.92	11.48, 31.18	1.67	0.076

Discussion

As with other orthopaedic fractures, in Monteggia fractures the impact of the use of traditional bonesetters on neglect was studied. Sargın et al. [12], have assessed the preference for the use of bonesetters and other influencing factors in Turkish society. The study emphasized that the use of bonesetters is prevalent in Turkey and that increasing the informative health education programs and more state supervision may be effective solutions.

The natural history of the disease is not benign if left untreated. It can lead to progressive valgus deformity, instability, and decreased range of motion. Surgery is advised to achieve anatomic reduction of the radial head, to prevent progressive valgus instability, and to improve cosmetic appearance and range of motion. Currently, many authors recommend surgical intervention when: 1) diagnosis is made early; 2) there is limited range of motion, weakness, progressing deformity, normal concave radial head, or convex capitellum, and 3) the family and the patient are aware of the benefits of reconstruction procedure. However, there are few large-scale studies related to surgical outcomes of neglected Monteggia fractures [3, 9, 10, 11, 13]. For that reason, there is a lack of consensus on the most appropriate age to perform surgery; ligamentoplasty; interval between the time of trauma and surgery; and the type of osteotomy in delayed cases with Monteggia fractures. According to Nakamura et al. [14], favorable outcomes can be expected in the long term in delayed cases, when the patient presents before 12 years of age and within three years after the trauma. We also observed that outcomes were worse with increasing age and interval. In chronic cases with Monteggia fractures, we can achieve less painful and more functional elbows with appropriate surgery and early rehabilitation. This is only if the interval is shorter than 12 months and patients are younger than 10 years old. While we observed four complications among patients older than 10 years old, we only saw one complication among patients younger than 10 years old. We think the reason for fewer complications is related to the fact that we had a high number of patients younger than 10 years old, with interval less than one year.

Ligament repair is a controversial issue and some authors stated it is not necessary [15]. If the head of the radius does not fit into place after angulation distraction osteotomy, then there should either be a pseudocapsule preventing reduction of the radial head or the remnant annular ligament should be stuck between the joint. For that reason, when the head of the radius does not fit into place with closed reduction, some authors performed arthrography, and made an excision under arthrographic guidance. According to the authors, additional surgical procedures would increase rigidity, AVN, heterotopic ossification, and radioulnar synostosis [16]. In one study, the authors detected annular ligaments that were stuck in the joint space and repaired five of them [17]. In one study, they repaired overturned annular ligaments in two patients [18]. In another study, the authors approved late repair of the annular ligament for better functioning and less long-term pain [19].

According to the generally accepted view, the major problem is the poor bone union in the ulna that prevents reduction of the head of the radius [20]. Nishio et al. [21] and Bouyala et al. [22] all reported on the use of ulnar osteotomy for the treatment of radial head dislocation after a missed Monteggia fracture. The concept of ulnar osteotomy in those reports was that the osteotomy tightened the interosseous membrane sufficiently to keep the radial head in a correct anatomical position.

Nevertheless, some authors preferred elongation with the use of an external fixator and correction of the angulation and did not perform open reduction in any patient. They reported their results as satisfactory [23].

Most authors gave advice on ligament repair together with osteotomy. Several methods have been proposed on the surgical procedures for reconstruction of the anular ligament such as using a free palmaris longus tendon [24], pedicled forearm fascia [25], pedicled fascia of the triceps [26, 8], and the remnant of the anular ligament [17].

Some authors approved of the late repair of the annular ligament for better functioning and less pain in the long term [19]. Delpont et al. [15] performed ligamentoplasty in one group of patients but did not perform it in the other group. They reported that the group that had ligament repair had better outcomes compared to those without repair. Nakamura et al. [14] initially used forearm fascia and then remnant annular ligament beginning from 1997, by augmenting them with free tendon grafts. They reported their outcomes were better.

We performed ligament repair in all our patients and saw a great benefit. In our opinion, annular ligament has great importance for maintaining the radial head in place, and it is statically and dynamically the main stabilizer. We think it is a more appropriate biological option to provide elbow restoration. The decision for ligament reconstruction was made after osteotomy. Since we could not achieve complete reduction of the radial head after osteotomy in any of our patients, we performed ligament repair in all of our patients. We did not detect prevention of rotational movements of the radial head due to ligament repair. Therefore, we approved of the ligament repair in terms of elbow biomechanics. Application of pins is rarely required if the performed ligamentoplasty and osteotomy provides appropriate tension. In our opinion, if the radial head is deformed and there are limited options, then a temporary condyloradial pin may be applied for 2-3 weeks. In our study, we did not detect any issues due to application of the condyloradial pin, whereas according to Delpont et al. [15] it is contraindicated.

A sturdy ulnar fixation is necessary in order to maintain the stability of the radial head. There is no consensus on the fixation methods for ulnar osteotomy. Since 11 of our patients had their fractures at the diaphysis region, angulation distraction osteotomy was performed in these patients. Metaphysial osteotomy was performed in the remaining patients. All diaphysis fractures were in short oblique, incomplete, and plastic deformation type. We had quite successful results with simple transverse osteotomy together with intramedullary pin application in four of our patients below 10 years of age. For children aged 10 years or older (regardless of the type of fracture) rigid osteosynthesis was performed using a plaque screw. Despite performing a 5-mm distraction to achieve adequate length in some of our patients, none of our patients required autograft, and as a result, bone union was achieved in all of our patients.

Conclusions

Early diagnosis, less than 1-year interval between the time of trauma and diagnosis, and patient age younger than 10 years are considered to be factors with favorable effects on treatment outcome. Ligament reconstruction, together with ulnar restoration, is a more biological option. This option restores the elbow biomechanics and increases performance. In addition, the use of condyloradial pins increase radial head stability in appropriate cases.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

Funding: None

Conflict of interest

None of the authors received any type of financial support that could be considered potential conflict of interest regarding the manuscript or its submission.

References

1. Bado JL. The Monteggia lesion. Clin Orthop Relat Res. 1967;50:71–86.
2. Rodgers WB, Waters PM, Hall JE. Chronic Monteggia lesions in children. Complications and results of reconstruction. J Bone Joint Surg Am. 1996;78:1322-9.
3. Inoue G, Shionoya K. Corrective ulnar osteotomy for malunited anterior Monteggia lesions in children. 12 patients followed for 1-12 years. Acta Orthop Scand. 1998;69:73-6.
4. Chen WS. Late neuropathy in chronic dislocation of the radial head. Report of two cases. Acta Orthop Scand. 1992;63:343-4.
5. Horii E, Nakamura R, Koh S, Inagaki H, Yajima H, Nakao E. Surgical treatment

for chronic radial head dislocation. J Bone Joint Surg Am. 2002;84(7):1183–8.
6. Boyd HB, Boals JC. The Monteggia lesion. A review of 159 cases. Clin Orthop Relat Res. 1969;66:94-100.
7. Morrey BF. Functional evaluation of the elbow. In: Saunders WB, editor. The Elbow and its disorders. 2nd ed Philadelphia; 1993. p. 95.
8. Kim HT, Conjares JN, Suh JT, Yoo CI. Chronic radial head dislocation in children,part 1: pathologic changes preventing stable reduction and surgical correction. J Pediatr Orthop . 2002;22(5):583-90.
9. Wang MN, Chang WN. Chronic posttraumatic anterior dislocation of the radial head in children: thirteen cases treated by open reduction, ulnar osteotomy, and annular ligament reconstruction through a Boyd incision. J Orthop Trauma. 2006;20(1):1-5.
10. Kim HT, Park BG, Suh JT, Yoo CI. Chronic radial head dislocation in children, part 2: results of open treatment and factors affecting final outcome. J Pediatr Orthop. 2002;22(5):591-7.
11. Tajima T, Yoshizu T. Treatment of long-standing dislocation of the radial head in neglected Monteggia fractures. J Hand Surg [Am]. 1995;20(3 Pt 2):S91-4.
12. Sargın S, Aslan A, Konya MN, Atik A, Meriç G. Bonesetter choice of Turkish society in musculoskeletal injuries and the affecting factors. J Clin and Experi Invest 2013; 4 (4): 477-482
13. Hasler CC, Von Laer L, Hell AK. Open reduction, ulnar osteotomy and external fixation for chronic anterior dislocation of the head of the radius. J Bone Joint Surg Br. 2005;87(1):88-94.
14. Nakamura K, Hirachi K, Uchiyama S, Takahara M, Minami A, Imaeda T,et al. Long-term clinical and radiographic outcomes after open reduction formissed Monteggia fracture dislocations in children. 2009;91(6):1394-404.
15. 14.Delpont M, Jouve JL, Sales de Gauzy J, Louahem D, Vialle R, Bollini G, Accadbled F, Cottalorda J.Orthop Traumatol Surg Res. 2014;100(7):803-7.
16. Lädermann A, Ceroni D, Lefèvre Y, De Rosa V, De Coulon G, Kaelin A. J Child Orthop. 2007;1(4):237-42.
17. Seel MJ, Peterson HA. Management of chronic posttraumatic radial head dislocation in children. J Pediatr Orthop. 1999;19(3):306-12.
18. Kalamchi A. Monteggia fracture-dislocation in children. Late treatment in two cases. J Bone Joint Surg Am. 1986;68(4):615-9.
19. Gyr BM, Stevens PM, Smith JT . Chronic Monteggia fractures in children: outcome after treatment with the Bell-Tawse procedure. J Pediatr Orthop B. 2004;13(6):402-6.
20. Judet R, Lord G, Roy-Camille R. [Osteotomy of the cubital diaphysis in old dislocations of the radial head in the child]. Presse Med. 1962;70:1307-8.
21. Nishio A, Toguchida K, Kuwahara K, Otsuki K. Treatment of the old Monteggia fracture-dislocation by osteotomy of the ulna. Saigai Igaku.1965;8:67-72.
22. Bouyala JM, Chrestian P, Ramaherison P. [High osteotomy of the ulna in the treatment of residual anterior dislocation following Monteggia fracture (author's transl)]. Chir Pediatr. 1978;19:201-3.
23. Exner GU (2001) Missed chronic anterior Monteggia lesion. Closed reduction by gradual lengthening and angulation of the ulna. J Bone Joint Surg Br. 2001;83(4):547-50.
24. Attarian DE. Annular ligament reconstruction in chronic posttraumatic radial head dislocation in children. Contemp Orthop. 1993;27:259-64
25. Hui JH, Sulaiman AR, Lee HC, Lam KS, Lee EH. Open reduction and annular ligament reconstruction with fascia of the forearm in chronic Monteggia lesions in children. J Pediatr Orthop. 2005;25:501-6.
26. David-West KS, Wilson NI, Sherlock DA, Bennet GC. Missed Monteggia injuries. Injury. 2005;36:1206-9.

How to cite this article:
Atiç R, Yıldırım A, Yiğit Ş, Aydın A. Neglected monteggia fracture-dislocations in children. J Clin Anal Med 2018;9(4): 323-8.